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Utilizing Journals in Mathematics

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Utilizing Journals in Mathematics

by

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A thesis submitted to the
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Carinne Ann Mull

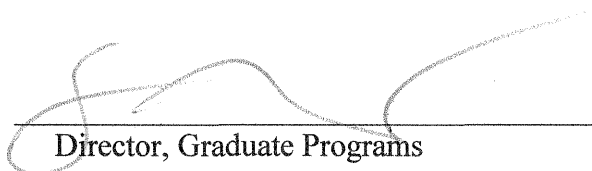
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Chapter 1: Introduction

Statement of the Problem

Many teachers implement writing into most subject areas, but tend to leave it out of their mathematics lessons. Teachers may not readily observe that the language in mathematics connects to habits of good writers. According to Mendez and Taube (2008), the progressions of the writing paradigm align with the process that a student must follow to solve a mathematics problem. The question remains, why do teachers often omit writing from their mathematics lessons?

Historically, mathematical lessons were geared towards student memorization or facts and recalling algorithms of mathematics problems. Math has moved towards students having to use critical thinking skills as they solve math problems. When students come across mathematics problems that involve higher order thinking skills, students cannot show their understanding solely through a single answer. Writing about the process that the student used to get to the answer would be more invaluable to the teacher in their understanding of how well their student understands the mathematical concept. Idris (2009), mentions that it takes more than memorizing of facts to show an understanding of a mathematics concept. Students must be able to communicate what they have learned to show that they understand the concept and they can do this by showing how they solved the problem through their writing.

It is not uncommon that a teacher teaches a mathematics lesson, the students show an understanding of the concept, and when the lesson is reviewed the following day, the students have difficulty remembering what they learned about in the previous

lesson. This means that using only math problems to teach a mathematics lesson may not allow students to develop a deeper understanding of the mathematics concept. According to Scheibelhut (1994), writing in mathematics allows the students to slowdown their thinking and allow them to be able to think about what they are doing, clear up any uncertainties about the mathematical process, and completely understand what they have learned. It is important to not only teach the student the mathematical concept, but also to ensure the students are able to retain the information that they have learned.

The sociocultural perspective highlights the idea that children learn through experience. This means that students learn values through problem solving and interactions within their society. More specifically, one element of the sociocultural perspective states, "Language is viewed not as one generic thing, but composed of a great variety of different styles, registers, or social languages" (Huang and Normandia, 2007, p. 296). Based on the sociocultural perspective, I believe that students gain knowledge by completing activities that are above their level with the assistance of a teacher who is knowledgeable about the subject. Incorporating journals in math lessons supports this idea because as students are learning new concepts, they are communicating their thoughts in writing and reinforcing their own learning. Journal writing is structured by the teacher who will guide the students in their written expression. With this guidance, students will communicate their thoughts and eventually develop an understanding of the lesson concept. Without the support of a knowledgeable person and the students participating in the act of journal writing,

meaning, comprehension, and application of the new math skills may be very challenging for them.

Some teachers may be apprehensive about integrating journal writing in mathematics because they are not sure how to effectively incorporate them into their instruction. Norwood and Carter (1994), have done research on journal writing in mathematics and have come up with a list of ten suggestions that teachers may use if they decide to incorporate journal writing in mathematics. One suggestion of Norwood and Carter (1994) includes introducing the journal writing process in the beginning of the year so that students can get in to the routine and are aware of expectations when they write in their journals. The authors also suggest setting a strict time limit that students must adhere to when writing and modeling journal writing so students know what they should be writing about. Also, Norwood and Carter (1994), add that it is important to be patient with those who might take longer than others when it comes to getting accustomed to writing in mathematics journals.

The research question that I intended to answer was: Does the use of student journals during mathematics impact student comprehension of mathematics concepts? This research is important because I have observed that at the end of a lesson, students seem to understand the new mathematical concept that was taught that day. However, on the following day, I will review the concept and often find a large amount of the students have forgotten what they had learned the previous day. As an educator, this can become discouraging because I have to re-teach previous lessons

before I can introduce the lesson for the day as the math lessons scaffold each other in difficulty and skills applied.

A common misconception in education is that students will learn a concept after one lesson. My objective was to provide each student with a math journal that they can revisit to assist in their recall during each math lesson. The math journals served two purposes. One purpose was to provide the students with a resource to reread and review for assistance during daily math lessons. The second purpose of the math journals was to maximize instructional time for the teacher.

Mathematics is not the only subject in which journal writing may benefit students' comprehension. Journal writing can also be easily applied in other content areas which may allow the students to develop a deeper understanding of the concepts that are taught. The uses of journals in content areas are realistic because they are affordable and teachers can easily implement them in their classroom. At first, the students may struggle with the process of writing in subject areas outside of writing, but eventually it will become a routine habit, resulting from repeated practice on a daily basis.

In order to carry out this study, I collected data from three sources: student journals, math assessments, and a checklist. Math journals were handed out to students and used on a daily basis. Each day during math class, students had about ten minutes before the conclusion of the mathematics lesson to write in their math journals. In the journals, the students explained the math concept of the day and how they used it to solve their math problems. The students also wrote new questions they

had or any other thoughts that they might like to add. The teacher collected the notebooks each day and wrote comments back to the students, checked to see if the student was accurate in his/her responses, answered any questions that the students had, and returned the journals to the students the following day. The journals were a tool that the students were able to use on a regular basis to reflect on and review prior concepts along with studying for assessments. The students were encouraged to use the journals on a regular basis as a guide while they are completing math assignments. I based my design for the journals on Norwood and Carter's (1994) suggestions for integrating journals in math classrooms.

In order to conduct my investigation, I also collected data using a checklist. This checklist provided information about the student's knowledge of the mathematical concept and the student's engagement during the mathematical activity. The checklist is divided into three sections in which the teacher can assess the students' knowledge and engagement of a concept during daily math lessons. I developed this checklist based on my personal experience that I had through teaching math classes. In this case, I first piloted the checklist within my classroom and made the necessary revisions so that it could be used in my study.

At the end of the unit, the students had an assessment to complete. The math assessment was teacher created based on the concepts taught during the unit. The assessments given before the incorporation of math journals were compared to the assessments given after the math journals were put into place.

The math journals were collected and analyzed each day. As I read the journals, I checked to see if the students were able to write about the mathematics lesson and explain the steps they used to solve the problem. In addition to reading the journals, I also took notes in a confidential log. The notes consisted of comments that I made pertaining to how well the students were able to explain the math concept in their journals. I used the notes from the confidential log to compare how well each student was able to explain the process used in order to solve the math problem in their journals with whether the student was able to solve the problem correctly on the assessment. I also used the data from the checklist to see if knowledge of the subject and engagement in the mathematical activity had an impact on journal writing and assessment scores.

Significance of the Problem

The research on the use of student journals during mathematics to determine if there is an impact on comprehension is important to me because I was experiencing a problem with my students developing a deeper understanding of math concepts. Therefore, I wanted to find a way to resolve this problem. I was hopeful that implementing journals in math would show improvements in assessment scores.

Writing provides an outlet of expressing one's thoughts on paper. In addition, those thoughts are visible for students to revisit and review when they are struggling with a math problem that was already covered. If journal writing in math helps students develop a deeper meaning of math concepts, then it could be helpful across all curricular areas at all grade levels. If teachers start implementing journal writing in

kindergarten, then it will become a routine to use throughout elementary and secondary schools. Students will have a reliable resource that they can review over the years that will assist them in their learning of math concepts.

Purpose

The purpose of this study was to determine if journal writing in mathematics increases student comprehension of the mathematics concept. When teaching mathematics to my students, I usually instruct using the format of modeling, guided practice, and the independent practice. By the end of the lesson, the students tend to be able to follow the steps in order to solve the problem, but they may not understand the reason for each step that must be followed in order to solve the problem. My hope was that when the students are forced to explain the process they used in order to solve the problem, it may result in the students having a better understanding of the importance of each step in solving the mathematics problem. I anticipated that when students are able to write about and understand the steps in a mathematics problem, it will increase their comprehension of the mathematics concept.

Rationale

If teachers begin to implement journal writing in mathematics, I believed that students would begin to develop a deeper understanding of the mathematics concept. If the students are able to comprehend the concept through the use of journal writing, then they should be able to come to school the following day able to recall what they had learned in the previous lesson. The teacher will not have to struggle by re-teaching the lesson from the previous day and fitting in the current lesson. This

should make a greater impact on student achievement in mathematics because many concepts in mathematics scaffold each other. If students do not remember or understand a concept in the beginning of the scaffolding process, then they will struggle with the rest of the concepts that build off of the original concept. With journal writing, not only will the students develop a deeper understanding of the mathematics concept, but have a source to use and review if they forget or are confused about a mathematics concept.

Summary

According to research, writing in mathematics is important because it helps develop a deeper understanding of math concepts. If this research is correct, then it is important to understand what the students write in their math journals. According to Huang and Normandia (2007), there is considerable research that supports the importance of writing in mathematics, but there is not a lot of research that examines the writing that is done by students. As I conducted my research, I hoped to study the content of what my students write in order to see if their writing is positively impacting their understanding of math concepts. If I found that journal writing in mathematics increases comprehension in mathematics, then I planned on incorporating journal writing into my mathematics lessons on a daily basis. The following chapter highlights critical research findings related to writing and comprehension.

Chapter 2: Literature Review

Introduction

Writing is a part of all subject areas, but in my experience, it is least commonly used in mathematics. According to the overall research findings, writing in mathematics has many benefits. They include: helping students develop a deeper understanding of a concept and assisting students when reflecting on what they have already learned. For several reasons, teachers choose not to incorporate writing into their mathematics lessons. I intend to highlight some of the benefits of incorporating writing into mathematical lessons and some of the reasons why teachers are not implementing writing into math lessons.

Theory Involving Writing in Mathematics

Huang and Normandia (2007) state, that incorporating writing in mathematics can be supported by the sociocultural perspective. The sociocultural perspective highlights the idea that children learn through experience. This means that students learn values through problem solving and interactions within others. A portion of this theory states, “Language is viewed not as one generic thing, but composed of a great variety of different styles, registers, or social languages” (Huang & Normandia, 2007, p. 296). They further add that students must be in a classroom with a person that is knowledgeable and actively communicating in the learning process in order to learn new concepts. When a student writes in mathematics, he/she is communicating with the support of the teacher and therefore by theory, should be able to develop a stronger understanding of math concepts. Journal writing is structured by the teacher

who will guide the students in their written expression. With this guidance, students will communicate their thoughts and eventually develop an understanding of the lesson concept. Without the support of a knowledgeable person and the students participating in the act of journal writing, meaning, comprehension, and application of the new math skills may be very challenging for them.

Benefits of Journal Writing in Mathematics

According to Bosse and Faulconer (2008), Fernsten (2007), Quinn and Wilson (1997), and Seto and Meel (2006), writing in mathematics is important because it helps develop a deeper meaning of math concepts. Fernsten (2007) adds that writing in math develops a deeper meaning of a math concept by forcing students to think clearly and communicate through written expression. Developing a deeper understanding of a mathematics concept is important because students can accurately execute math problems in the future if they have a profound understanding of the concept.

Researchers agree with the notion that writing in mathematics assists students in ordering their thoughts so that they can be clearly communicated (Mendez & Taube, 1997; Pugalee, 2001; Scheibelhut, 1994; and Seto & Meel, 2006). Pugalle (2001), adds that journal writing is a form of communication and communication assists when it comes to clarifying and comprehension of mathematical concepts. Scheibelhut (1994) also adds that when students are writing, they are forced to slow their thinking which allows them to clarify what they have learned so that they understand a new concept and connect it to what they already know. Slowing down

and organizing thoughts are important in mathematics because it forces students to take a look at what they have already learned, think about what it means to them, and demonstrate how well they understand the concept. From my experiences, this helps students because many times students rush through math assignments just to get them done without truly comprehending or applying the math skills they learned. If they are forced to slow down through writing, then it gives the students the opportunity to think more about what they have learned rather than rushing to complete the math assignment.

Baxter, Woodward, and Olsen (2005) and Scheibelhut (1994), agree that journal writing during mathematics class not only helps to clarify thoughts and organize ideas, but it also assists the students in finding their own errors as they are working out math problems. Many times students rush through problems and make careless mistakes during mathematics. Having the students write in journals during mathematics forces the students to take a look at what they have done and allows them to see where they might have made any errors as they are working through a mathematics problem. As a result, the students will be able to become more independent during mathematics because their journal writing will allow them to find their own errors and answer their own questions that they would have previously needed the teacher's assistance (Baxter, Woodward, & Olsen, 2005).

Ediger (2006), Mendez and Taube (1997), and Norwood and Carter (1994) mention, that writing in mathematics is essential because it allows students to reflect on what they have learned in their daily math lessons. Reflection is important

because it is a time when students can look back at what they have learned, think about what they have practiced, thought about, and studied, and tie it in with what they already know. Mendez and Taube (1997), add that an important part of reflection in mathematics is looking back on how thoughts were developed. This is an important process because it is a time when students recognize mistakes they may have made along the way or it helps them to understand a concept that they have been struggling to learn.

According to Ediger (2006), math journals are important because they help students reflect on what they have learned in math lessons. Ediger states, “Thinking about mathematical experiences helps students to analyze, synthesize, and evaluate what has transpired in order to grow in mathematics achievement” (2006, p. 120). If students are not given the opportunity to write about what they have learned in math, then it will not make the lesson as meaningful; students will have a greater chance of losing the knowledge that they have gained during math lessons.

A benefit to writing in mathematics is that it requires students to use higher level thinking skills. Idris (2009) asserts that when students write in journals, it forces them to understand the mathematics problem more deeply because the methods that were used to solve it must be explained. Journal writing forces students to be able to recall sequential steps and also requires students to be able to create meaning for each step in a mathematical problem (Idris, 2009). This leads to a deeper understanding of the mathematical concept.

Idris (2009) and Norwood and Carter (1994), argue that many teachers only pay attention to the answer in a mathematics problem and ignore the steps that the student took on order to get to the answer in the problem. Idris adds that because of the emphasis that is placed on the final answer of the problem, many students simply memorize algorithms without truly understanding the purpose of each step. In order for students to develop an understanding of the purpose of each step in a mathematics problem, teachers should incorporate journal writing as a part of the mathematical process. As a result, students will demonstrate an increase in comprehension of the mathematical concept (1994).

Quinn and Wilson (1997) and Seto and Meel (2006) both state that writing in mathematics increases students' intrinsic motivation because it gives students the opportunity to share their thoughts about math concepts. The authors agree that intrinsic motivation is increased when students have an opportunity to communicate feelings that they have in the area of mathematics (Quinn & Wilson, 1997 and Seto & Meel, 2007). It is important for students to have a voice in what they are learning because it provides a stronger sense of responsibility, which increases their motivational level.

Many students develop a negative attitude towards mathematics when they are having difficulties with a concept or do not understand something (Scheilbelhut, 1994). Scheilbelhut notes, that when students write in journals during mathematics, teachers can see negative attitudes developing through their writing. When teachers see these negative attitudes, they teacher can take appropriate action to change the

bad feelings the student is having towards mathematics. Writing in mathematics allows issues that the students have to be addressed which will prevent the growth of negative feelings towards mathematics (1994).

According to Baxter, Woodward, and Olson (2005), writing in mathematics is important because it allows students to thoroughly express their thoughts through various types of written communication. Teachers ask students questions to try and measure understanding of a concept. However, time constraints do not allow for each student to give thoughtful answers, which could be expressed through written communication (Baxter, Woodward & Olson, 2005). Journal writing in mathematics gives each student the opportunity to express their thoughts in mathematics to the teacher on a regular basis. If a teacher relied on only oral communication from the students, then they would not be able to hear from each student as often and it would take up a lot more time.

Writing in mathematics is important to all students, including those that are introverted. Baxter, Woodward, and Olson (2005) argue that writing in math allows students who are introverted to be more involved in a mathematics lesson by personally writing their feelings and reactions to the learning. Introverted students often tend to avoid raising their hand or participating in class discussions. If all students had to write their thoughts, then introverted students would have an equal opportunity to express their thinking through their journal entries related to math.

Part of the research by Seto and Meel (2006) includes email math journals that were used on a weekly basis as a form of communication between the teacher and the

student. Seto and Meel found that these electronic journals had many benefits, such as a solid place where teachers and students could converse with each other about daily math lessons, a place where students could write down their thoughts about lessons at any time, and provides the teacher with a tool to keep track of the students' knowledge of a math concept. Another benefit of electronic math journals is the fact that they place more responsibility on students because if a student is having difficulty with a particular math concept, then it would show through the journal entries. Therefore, it is the student's responsibility to take the initiative to seek help with understanding the concept (Seto & Meel, 2006).

According to research by Quinn and Wilson (1997), math journals are an excellent way to help students develop a deeper meaning of math concepts. Quinn and Wilson describe several types of journals that could be implemented into math classrooms. According to Quinn and Wilson, "The use of pictorial journals by elementary and middle school students promotes a better understanding and retention of mathematical concepts, decreases 'math anxiety,' and gives students a feeling of ownership of the material" (1997, p. 14). Quinn and Wilson further found that journal entries are important because they assist students with their thought processes, which allows students to gain a better understanding of their own knowledge of the math content.

Baxter, Woodward, and Olson (2005) studied the impact of journal writing in mathematics and found many benefits. Throughout their research, they emphasized how math journals are an excellent source of communication between the teacher and

student. This connection between the teacher and student has many benefits, including the fact that teachers can monitor each student's knowledge of math concepts more closely, understand what their students are thinking, and build relationships between the teacher and the student that allow students to communicate privately about mathematical ideas in a non-threatening way (2005).

In a study completed by Seto and Meel (2006), the researchers found that not only does journal writing in mathematics increase communication between the student and the teacher, but it also assists in developing a good connection between the student and the teacher. When students write in their mathematics journals, they are given a time where they can express their feelings and share information about themselves that normally the student might not have had the chance to share with the teacher. Journal writing gives the students the opportunity to share with the teacher feedback that they may have, questions that they still have, and topics that interest them so that the teacher can integrate those topic into future class lessons (Seto & Meel, 2006). It is important for teachers to have good relationships with each student in their classroom. Journal writing in mathematics is one strategy that teachers can incorporate into their math lessons which can help strengthen the relationship between the student and the teacher.

Carter (2009) and Norwood and Carter (1994) claim, there are many benefits to journal writing in math, including the fact that math journals help students link various math concepts and also show a relationship between math and other subjects. Making these connections is imperative because it shows students the importance of

math and its relationships outside of the classroom. Norwood and Carter (1994) claim that math journals are a great form of assessment and can be easily implemented in the classroom because they are convenient to use and reasonably priced. Journals are an excellent tool for teachers to use because they allow teachers to dictate how they want to organize the structure of their students' journals; this journal arrangement has endless possibilities for instruction and practical usage.

An advantage of incorporating writing into mathematics is that the steps in the writing process align with the steps involved in solving a mathematics problem (Mendez & Taube, 1997). Mendez and Taube state that the steps of the writing process consist of brainstorming, planning, rough draft, editing and final copy. The steps on the problem solving process include comprehending the problem, making a plan, implementing the plan, and checking your work (1997). Many students might be apprehensive about writing in mathematics because it is not something that they are familiar with. If the teacher shows the similarities between the writing process, that they are already familiar with, and the problem solving process, then students might be more accepting of the idea of writing in mathematics because it can be connected to the writing process in which the students are already familiar with.

Journal writing is an important part of mathematics because it gives students the opportunity to make connections between mathematics and their individual lives (Carter, 2009). Many times connections between mathematics and students' lives assists students with their comprehension of the mathematics concept. When students are given the opportunity to write in journals during mathematics, it gives them the

opportunity to bridge the gap that many students have between mathematics and their everyday lives (Carter, 2009).

Idris (2009), argues that a benefit of journal writing in mathematics is that it assists teachers in differentiating their instruction. Each student in the class is on a different level of understanding in mathematics. Therefore, teachers can give different problems to students to write about in their journals that are at the appropriate level of the student. Differentiating instruction prevents students from getting frustrated during mathematics due to a concept being too easy or too hard. It also allows teachers to give the students individual instruction necessary for them to achieve mastery of a concept at their own pace (Idris, 2001).

One advantage of journal writing in mathematics is that it has shown to increase the level of student enthusiasm in writing (Carter, 2009, Scheibelhut, 1994). According to Carter, many students view writing as a boring subject and do not have much interest in it. Incorporating writing into mathematics helped students to have more of a positive attitude when it came time to write because it made writing seem fresh and exciting (2009). It is important to find ways to keep students motivated in all subject areas because the knowledge that students gain in all subject areas will help them live and function as they grow in society.

Writing as a Form of Assessment

Drake and Barlow (2007), Ediger (2006), Norwood and Carter (1994), Pugalee (2001), Scheibelhut (1994), and Seto and Meel (2006), argue that writing in mathematics is an important tool that teachers can use to help them assess their

students understanding of a math concept. Drake and Barlow (2007) and Norwood and Carter (1994) confirm that many assessments given to students do not accurately measure a student's understanding of a math concept. Therefore, by implementing writing in mathematics classes, it can be used as a more accurate assessment tool that provides the teacher with more valuable information than a typical assessment because students are asked to explain math concepts, as opposed to just providing an answer to a math problem.

Researchers agree that writing in mathematics not only provides the teacher with information about their students' understanding of a math concept, but it also provides a useful way to assess which teaching strategies work best in his/her classroom (Pugalee, 2001, Scheibelhut, 1994, Seto & Meel, 2006). Each class is unique and the teacher must adapt the instruction to the needs of the students within the classroom. In this case, it is important for teachers to understand which teaching strategies are most effective to use. This can be done in mathematics through journal writing because the students can communicate how they learn best and what strategies are not working well for them.

Pugalee (2001), adds that when writing is used as a form of assessment, it provides the teacher with information on what needs to be retaught to the students in class and which students need additional help in mathematics. Using writing within mathematical assessments also helps the teacher to grow as an educator because it shows what went well in a lesson, or where teachers need to modify and improve their lessons for the following year (Pugalee, 2001). Baxter, Woodward, and Olson

(2005) and Mendez and Taube (1997) report that writing in mathematics is not only an important assessment tool for teachers, but it provides an excellent tool for students to use when measuring their own understanding of a math concept. In addition, Baxter, Woodward, and Olson (2005) note that in mathematics, it is important for students to use written communication to help them solve problems they are experiencing because as a student writes what he/she is thinking, the student often sees the mistakes made and ultimately solves them independently.

Researches agree that incorporating writing into mathematics assessments is important because it fulfills a requirement of the National Council of Teachers of Mathematics (NCTM) standards (Baxter, Woodward, & Olson, 2005; Bosse & Faulconer, 2008; and Drake & Barlow, 2007). According to Drake and Barlow, the standard that journal writing in mathematics addresses is the communication standard because the students must write about what they are thinking in their journal (2007). It is important to fulfill this standard within an assessment and writing in mathematics is an easy and accurate way to assess this standard.

Drake and Barlow (2007), further claim that problem writing is an excellent form of assessment in mathematics. When students write a problem in mathematics, they must demonstrate two things. The first is their ability to use correct mathematical vocabulary in their problem and the second is the students' ability to write a question that can be answered based on the information given in the word problem (Drake & Barlow, 2007). When students write a word problem correctly, they are demonstrating understanding of the mathematical concept. A student cannot write a

word problem on a concept that they do not have proficiency in because they will not be able to formulate a question on a concept that they do not understand. Drake and Barlow add that another benefit of problem writing is that improves student problem solving skills by forcing students to use creativity and reasoning as they write their own word problems.

Journal Writing and Teacher Apprehension

According to Fernsten (2007), Hopkins (2007), and Seto and Meel (2006), many secondary teachers do not integrate writing into mathematics because they do not feel that they are proficient enough in writing to be able to teach it. Seto and Meel (2006) add that not only do teachers feel uncomfortable teaching writing, but they do not know how to accurately score written assignments. Fernsten (2007) state, that teachers who only teach mathematics without the writing component feel uncomfortable teaching writing because the only knowledge they have of writing is from the papers they wrote and submitted themselves in other content areas.

Bosse and Faulconer (2008) and Hopkins (2007), assert that teachers are not implementing writing into mathematics because of their lack of resources in both materials and strategies on how to teach it. Even though there is research that states the importance of incorporating writing into mathematics, many districts still do not provide their teachers with resources and professional development that will assist them in developing a mathematics program that includes journal writing (Hopkins, 2007).

According to Quinn and Wilson (1997) and Seto and Meel (2006), teachers do not incorporate writing into mathematics due to time constraints. Quinn and Wilson assert that many teachers have a lot of pressure on them to complete specific curriculum guidelines within a certain time frame and in some cases, find it impossible to fit any new instruction into the time allotment given to them. Seto and Meel state that time issues arise when teachers have to put together lessons in mathematics that they are unfamiliar with, fit the lessons in with an already tightly packed curriculum, and then score the assignments. Although writing in mathematics is beneficial, many teachers tend not to incorporate it into lessons due to time restrictions and an overloaded curriculum to instruct (2006).

Idris (2009) agrees with Seto and Meel (2006) and states that in order for journal writing in mathematics to be successful, it requires the teacher to implement journals in a regular basis and provide feedback to the students. Teachers have many responsibilities for their job and in many cases, already put in extra hours that they do not get compensated for. Taking time to comment on journals is just one more duty that a teacher will have to do each day and therefore many teachers will not implement journals into their classroom because they are not willing to spend the extra time it takes to make the mathematics journals successful. Even though journal writing can be time consuming, it can be an important tool towards achievement in mathematics (Idris, 2001).

Mathematics teachers are encouraged to implement journal writing into mathematics, but choose not to because they feel that there is not enough research to

support the benefits of journal writing in the classroom (Pugalee, 2001). Pugalee states, there is a lack of evidence that supports the idea that journal writing assists students in improving metacognition of mathematical concepts. There is also a lack of information to support teachers in assisting students in developing metacognitive behaviors during their journal writing (2001). With the lack of information regarding journal writing in mathematics and strategies for implementing journal writing in the classroom, teachers may be apprehensive about incorporating writing into their mathematics lessons.

Quinn and Wilson argue that teachers do not incorporate journal writing into mathematics lessons because they feel that writing is not a strength for their students. Students have difficulty when it comes to writing, which leads to negative attitudes, and therefore teachers avoid adding extra writing assignments into their daily lessons (1997). Ediger (2006), adds that student writing in mathematics does not have to be exceptional. Teachers must remember that the emphasis in journal writing should be on the process that the student took in order to get to the answer, not the writing itself. Over time, students writing will improve because the more you do something, the better that you become at it. Attitudes may even improve in writing because the more students write and improve their skills, the easier they will find writing which will help them to develop improved feelings towards the subject (2006).

Chapter 3: Applications and Evaluation

Introduction

The purpose of this study was to determine if journal writing in mathematics would increase comprehension of the mathematics concept and result in students meeting grade level standards on their mathematics assessments. After reading articles about the benefits of incorporating writing into mathematics, I decided to test it out in my class room. I wanted to see if journal writing would make a positive impact on comprehension and assessment scores of students who are not meeting grade level standards in my classroom.

Participants

The participants in the study were from one city school in upstate New York in a classroom that was predominately African American, but also included Hispanics, Latinos, and Caucasians. The general classroom selected was a fifth grade classroom that was an integrated special classroom. An integrated special classroom means that there are both general education students as well as special education students in the classroom along with a full time special education teacher. Half of the students had individualized educational plans (IEP) while the other half did not have IEP's. From that classroom, a total of six students were selected to participate in the study. Three students were chosen from each of the following two categories: students working toward meeting New York State Standards and students not meeting New York State math standards. The students' names were drawn from a hat based on the categories listed above.

The three students involved in this study who were working towards meeting grade level standards in mathematics were put into this category based on assessment grades for the 2009-2010 school years and based on scores from the 2009 New York State mathematics test. These students were labeled 1, 2, and 3. All three of the students in this category demonstrated understanding of the mathematics concept taught during previous mathematics lessons. These three students showed difficulty producing the same level of work during the work period at the time of the assessment. The students demonstrated this by being able to correctly solve problems and discuss them during class and then when it came to the assessment, they were not able to correctly solve the same type of problem.

The three students involved in this study who were not meeting standards in mathematics were put into this category based on assessment grades for the 2009-2010 school years and based on scores from the 2009 New York State mathematics test. These students were labeled numbers 4, 5, and 6. The three students always put effort into their work during the work period, but often had difficulty fully understanding the concept that was taught during mathematics. These students often needed assistance from the teacher during the work period. On mathematics assessments, these students were likely to have difficulty producing the same level of work that they produced during the work period.

Instruments for study

In order to conduct this study, I collected data from three sources: student journals, math assessments, and a student checklist (see Appendix A). The purpose of

the mathematics journals was for students to write in each day at the end of the mathematics period. During this time, I would use the checklist to track student engagement in the mathematics activity and knowledge of the concept. Two assessments were used to observe differences in scores from before journals were implemented into mathematics lessons to after students began writing in mathematics journals.

Math journals were handed out to students and used on a daily basis. Prior to the end of each math class, students had about ten minutes to write in their math journals. In their journals, students explained the math concept of the day and how they used it to solve their math problems. Students also wrote new questions they had or any other thoughts that they might like to add. I collected the notebooks each day and wrote comments back to the students, checked to see if the student was accurate in his/her responses, answered any questions that the students may have had, and returned the journals to the students the following day. The journals were a tool that the students were able to use on a regular basis to reflect back on, review prior concepts, and study for assessments. Students were encouraged to use the journals on a regular basis as a guide while they were completing math assignments. I based my design for the journals on Norwood and Carter's (1994) suggestions for integrating journals in math classrooms.

I also collected data through a checklist. This checklist provided information about the student's knowledge of the mathematical concept and the student's engagement during the mathematic activity. The checklists were divided into three

sections in which I could assess the students' knowledge and engagement of a concept during daily math lessons. The three sections of the checklist were titled: mini lesson, work period, and closure. There was also a section where I could write comments.

The mini lesson section consisted of statements about previous knowledge of the mathematical concept, if the students were engaged and participating in the lesson, and how well each student communicated. The work period section consisted of statements pertaining to how quickly the student began his/her work, how the student chose to work, whether the student was engaged and focused, and how accurately the work was completed with or without teacher support. The closure section contained statements about student participation in the closure and how well the student could explain how they solved the assigned math problems. I developed this checklist based on my personal experience that I have through teaching math classes because I did not find any research that pertains to using a checklist in this manner. In this case, I first piloted the checklist in my classroom and made the necessary revisions so that it could be used in my study.

At the end of each chapter in the study, the students completed an assessment. The first assessment (see Appendix B) was given before journals were implemented into mathematics. The second assessment (see Appendix C) was given after journals were incorporated into mathematics. The math assessments were created by the teacher. Both assessments had a total of ten questions with the first four questions asking students to solve problems by completing the number sentences. The next four

questions were multiple choice questions. The last two questions were extended response questions in which the students were asked to solve a word problem by showing their work and explaining the steps that they took in order to come up with their answer. The assessments that were given before the incorporation of math journals were compared to the assessments that were given after the math journals were put into place.

Procedures for study

In order to conduct the study, I began the first two to three weeks of the study by teaching a unit on adding and subtracting decimals in which the students involved in the study did not write in mathematics journals. During this time, I used the checklist to track students' knowledge of the subject and engagement in the lesson. At the conclusion of the unit, students were given an assessment on adding and subtracting decimals.

The second part of the study involved the participants writing in mathematics journals and lasted two to three weeks. The unit covered multiplying and dividing decimals. During this unit, students spent the last ten minutes of the work period each day writing in their mathematics journals. During this time, a multiplication or division of decimals problem was given to the participants. Students were also asked to solve the problem and explain the process they used to solve the mathematical problem. At the conclusion of the unit, students were given an assessment on multiplying and dividing decimals.

The math journals were collected and analyzed each day. As I read the journals, I checked to see if students were able to write about the mathematics lesson and explain the steps that one must follow in order to solve the problem. In addition to reading the journals, I took notes in a confidential log. The notes consisted of comments that I made pertaining to how well the students were able to explain the math concept. I used the notes from the log to compare student explanations of the math problem in their journals with whether the student was able to solve the problem correctly on the assessment.

Data from the checklists were collected each day from three of the six participants. A checklist was filled out for each participant in the study every other day. When the data collection was complete, checklists were organized according to student number. I then looked at the checklists completed one student at a time and analyzed them. I also used the data from the checklist to see if knowledge of the subject and engagement in the mathematical activity had an impact on journal writing and assessment scores.

After the final assessment was given on multiplying and dividing decimals, I analyzed how well the participants scored on it compared to the assessment on adding and subtracting decimals that was given before the journals were incorporated in math. I looked at how each student explained their answers and compared pre-math journal assessments to the post math journal assessments to see if the implementation of writing helped students explain their answers from the given math problems in a clearer more precise way.

After individual analyses of math journals, checklists, and assessments were completed, I began to analyze data from all three areas. I first checked to see if there was any relationship between students' writing in their mathematics journals and improvements in the students' assessment scores prior to the journals being introduced and used in the math lessons. The checklist was used along with the journals and the assessments to determine if there were any common trends when it came to knowledge of the math concept and engagement during the lesson.

From the data collected, I hoped to see if the incorporation of math journals assisted students to developing a deeper understanding of mathematics concepts which would be demonstrated by an improvement from the score of the first assessment to the second assessment.

Chapter 4: Results

The purpose of this study was to determine if journal writing in mathematics would increase student comprehension of the mathematics concept. In order to determine if journal writing during mathematics helped students to develop a deeper understanding of the mathematics concept, I implemented journal writing into my mathematics lessons.

It was imperative that I completed this study over the course of two chapters in mathematics. The study required me to collect data over two mathematics chapters because I wanted to see if there was any growth in assessment scores from before mathematics journals were implemented, to after they were implemented during daily mathematics lessons. Both assessments asked the same amount of questions and also asked the same types of questions (complete the number sentence, multiple choice, and extended response). The only difference between the two assessments was that the first assessment focused on adding and subtracting decimals and the second assessment, on multiplying and dividing decimals.

During this study, I utilized a check list to collect student data. The checklist measured student engagement in the mathematics activity and knowledge of the mathematical concept. Having prior knowledge of the mathematics concept or consistently not engaging in the mathematics activity could result in an increase or decrease in assessment scores.

Each day the students had about ten to fifteen minutes to solve a mathematics problem that was given to them and write about the process that they took in order to

solve the problem. Students could also include in their journals any remaining questions that they may have or other comments that they wished to make. I collected the journals each day and read and responded to each student participant in the study. I looked to see if the students understood the mathematics concept of the day, answered any questions the student participants may have had, and provided feedback to the students.

At the conclusion of the study, I compiled my data and organized the results. The scores of the assessments were organized into two tables. The first table focused on the participants overall assessment scores from before and after the journals had been implemented into the mathematics lesson. The second table focused on the participants' scores from only the extended response section of the both assessments included in the study. I also looked at the student journals to determine how well the participants were able to write about the mathematics concept compared to pre and post assessment scores.

This study was based on two mathematics chapters. The first chapter, on adding and subtracting decimals, was taught to the students without implementing mathematics journals. The second chapter, on multiplying and dividing decimals, was the chapter where journals were implemented into the lesson for the last ten to fifteen minutes of class. Table 1 below represents the scores of the students before journals were implemented into the class and after the journals were implemented into the classroom. The table is organized by listing each participant and their scores before and after journals were incorporated into mathematics.

Table 1: Assessment Scores Before and After the Implementation of Mathematics Journals

Participant Number	Score on Assessment Before Journals Were Implemented (Out of 12 Points)*	Score on Assessment After Journals were Implemented (Out of 12 Points)*
1	10	11
2	10	12
3	9	11
4	6	8
5	5	6
6	6	6

* 10-12 = meeting grade level standards.

7- 9 = working towards meeting grade level standards.

0- 6 = not meeting grade level standards.

Results from the assessment scores show that all but one participant showed growth in their assessment scores from before writing in mathematics to after journal writing was implemented into mathematics lessons. Three out of the six participants showed an increase of two points from the first assessment to the second assessment. Two out of the six participants increased their assessment score by one point.

Participant 6 did not show growth in their assessment score. The assessment scores remained the same on the first and second assessments. Based on the data collected from the checklist, the participant did not have a great deal of prior knowledge on any of the mathematics concepts that were taught over the course of the two mathematics assessments. This participant was also frequently absent during the course of this study and therefore, did not get the same instruction the other students in the class received. Also, as I reviewed the journals written by Participant 6, I found that the student never showed a complete understanding of the mathematics problem through their writing.

Participants 1 and 2 both showed growth between the first and second assessments. Both participants received scores that were meeting grade level standards on both of the assessments because they received a score of ten or higher. Based on the data collected from the checklist, participants' numbers 1 and 2 both had some prior knowledge before each lesson was taught. These students also correctly completed their class work each day, participated in the mini lesson and closure, and were able to correctly explain, in their mathematics journals, the process they used in order to figure out the answer.

Participants 3 and 4 both showed an increase of two points from the first assessment to the second assessment. Additionally, Participant 3 moved from working towards meeting grade level standards to meeting grade level standards and Participant 4 moved from not meeting grade level standards to working towards meeting grade level standards. According to the checklist, both of these participants

only had little prior knowledge of the mathematics concepts that were taught during this study. Also, these participants showed engagement in lessons each day by participating in the lesson and closure and completing their work during the class period. These participants demonstrated their interest in learning the mathematics concepts each day by asking questions when they did not understand something and checking with me to see if their answers to the questions assigned during the work period were correct.

In conclusion, the results from Table 1 show that 83.3% of the students showed an increase from the first assessment to the second assessment. The students who improved from the first assessment to the second assessment increased their scores by one to two points. The results of both assessments suggest that journal writing in mathematics had a positive impact on student comprehension of the mathematics concept.

During the study, a checklist was utilized to track student engagement in the mathematics activity and student knowledge of the concept that was taught. A checklist was filled out for three participants each day. Therefore, the checklist was completed for each student every other lesson that was taught.

As I completed the checklists during the first mathematics unit, where students did not write in their journals, I found that it was very difficult to get participation from the class. When I asked a question, the same hands were always raised to give answers. I even made a conscience effort to allow appropriate wait time after the question was asked. Because of the lack of student participation, I was forced to randomly select students' names that were written on popsicle sticks to answer questions in order to assess student knowledge of the subject.

Another observation that was noted in the checklist was that during the first mathematics unit in the study, before journal writing was introduced into mathematics lessons, the participants often found it difficult to stay on task during the work period. They often needed reminders about making good choices about who they were working with and to return their focus to their assignment.

After journals were implemented into mathematics lessons, I noted behavior changes as I filled out the checklists. It seemed that the students needed fewer reminders about staying on task during the work period and participated more as I used questioning strategies during my lessons. I noted that the participants seemed to be a little chattier during the work period, but as I listened to the students' conversations, they tended to relate to the mathematics lesson. The students began to

share mathematics strategies and compare answers to problems with each other. They also seemed to be more willing to help each other out when a classmate was stuck.

During the second mathematics unit of the study, I eventually no longer had to use popsicle sticks in order to get participation from all of the students. The students now had a resource to look back at if they did not remember something and they learned to use it to their advantage. I noted that students would often open their journals and review what they had written down in order to assist them in answering questions. Not only did I see an increase in participation, but I also noticed that more students seemed to be paying attention during my lessons.

In conclusion, the results of the checklist show that after journal writing was implemented into mathematics lessons, student participation and engagement during lessons increased. The journals gave the students a resource to use and after the students learned how to use their journals as a reference tool, they seemed to maintain more of a focus during daily mathematics lessons.

The assessments that were given before and after journals were implemented into mathematics lessons were broken up into three sections: complete the number sentence by finding the answer questions, multiple choice questions, and extended response questions. Table 2, found on the next page, focuses solely on the extended response portion of both assessments. The extended response section of the assessment accounted for four out of twelve points on the assessment. Both assessments contained two extended response questions. For each question, the participants were given a word problem to solve. After the participants solved the word problem, they were asked to explain the process they used in order to find their answer. Each question was worth two points. The participants received one point for answering the word problem correctly and another point for explaining the process that they used to solve the problem. This means that even if the participants did not answer the word problem correctly, they could still receive partial credit if their explanation of the process that they used to solve the problem matched the work that they showed.

Table 2 displays the scores that the six participants received on the extended response sections on both assessments. The table is organized by listing each participant and their scores on the extended response section of the assessments before and after journals were implemented into mathematics lessons.

Table 2: Extended Response Scores Before and After Journal Writing Was Implemented into Mathematics

Participant Number	Score on Assessment (Extended Response Questions) Before Journals Were Implemented (*Out of 4 Points)	Score on Assessment (Extended Response Questions) After Journals Were Implemented (*Out of 4 Points)
1	3	3
2	3	4
3	4	4
4	2	2
5	0	1
6	1	2

* 3-4 = meeting grade level standards.

2 = working towards meeting grade level standards.

0-1 = not meeting grade level standards.

The results of Table 2 show that all participants in the study either scored the same or higher on the extended response portion of their mathematics assessment after journal writing was implemented into mathematics. Fifty percent of the participants scores stayed the same for both assessments and fifty percent of the participants scores increased after journals were introduced into mathematics.

The results displayed in Table 2 suggest that incorporating journal writing in mathematics benefited some students in the class by increasing their assessment scores. The increased assessment scores of the participants imply that journal writing in math increased comprehension of the mathematics concepts resulting in students scoring the same or higher on their second assessment.

Participants 1, 2, and 3 typically were able to correctly write about the process that they used in order to solve the mathematics problem. As I read through their mathematics journals, I saw that these participants had a good understanding of the

mathematics concept. The participants demonstrated an understanding of the mathematics concept in their journals by correctly solving the mathematics problem and then being able to clearly write about the process they used in order to solve the problem. These students used correct vocabulary and were extremely detailed as they wrote out how they solved the mathematics problem. As a result, on the mathematics assessment, the participants were able to receive a three or a four which is considered meeting grade level standards.

Participants 5 and 6 are two of the students in the class who are not meeting grade level standards in mathematics. Each of these participants showed a growth of one point on the assessment after journals were implemented into mathematics. Participant 6 also went from not meeting standards on the first assessment to working towards meeting standards on the second assessment. After reviewing mathematics journals each day, both of these participants were rarely able to show a complete understanding of the mathematics concept that was taught each day. These participants were often not able to use the correct vocabulary as they wrote in their journals or they used words that are primarily used at the primary level and are no longer used in fifth grade. For example, both of these participants often used the word plus, which is primary level vocabulary, as opposed to sum, total, or altogether which is vocabulary used more at the intermediate level. Even though participants 5 and 6 did not show a complete understanding of the mathematics concepts as they wrote in their journals, these participants were still able to increase their scores on the extended response section of their second mathematics assessment.

The results of these participants' assessments suggest that journal writing in mathematics did have a positive impact on their comprehension of mathematics assessments. This assertion can be made because both participants showed an increase on the extended response portion of their second mathematics assessment which was given after journal writing was implemented into daily mathematics lessons.

Chapter 5: Conclusions and Recommendations

Analysis

In order to assess the efficacy of using writing journals to affect mathematical understanding of concepts, data was collected and analyzed from several sources. Data for this study was collected through a checklist, mathematics journals, and scores from two assessments. The results of this study suggest that incorporating journal writing in mathematics had a positive impact on comprehension of the mathematics concept. This was shown through an increase in assessment scores by the majority of the participants, from the first assessment, before journal writing was introduced into mathematics lessons, to the second assessment which was given after journal writing was implemented into daily mathematics lessons.

After reviewing the checklists that were filled out during the study, I found an increase in participation from the beginning of the study to the end of the study. Usually, I have to pull sticks out of a cup because of a lack of participation when I ask review questions regarding concepts were already covered. After journal writing was introduced into mathematics, the students tended to raise their hands more when I asked questions and I even saw them looking back into their journals to assist them in answering questions.

As I read through the participants mathematics journals each day, I found that the participants writing improved over the two to three weeks that they wrote in their journals. When journal writing in mathematics was introduced, the journal entries were short and did not include a lot of details or vocabulary, and the students did not

communicate to me. After the participants saw that I was reading their journals on a daily basis and writing back to them, their journal entries became more detailed, they added in some vocabulary, and even started writing comments and questions to me. By the end of the study, the journals served as a communication link between the participants and me and also as an informal assessment tool that I could use to track each participant's understanding of the mathematics concept.

After journal writing was implemented into mathematics lessons, I encouraged the students to use the journals that they wrote in as a reference tool. When the participants came to me with a question about a concept that was taught previously, I requested that the participants go back to their journals and read through them to see if they could answer their own question. On many occasions, the journal entries written by the students answered their own questions. It was not uncommon that the students' questions were areas that were already covered in class. The participants just forgot what they were supposed to do. If this were the case, then the participants could answer their own questions by reviewing their mathematics journals. By the end of the study, the participants started looking back at their journals when they had a question without me having to tell them to do so.

Journal writing in mathematics was a great informal assessment tool for me to use in class to find out the level of understanding each participant had in mathematics. After reading the participants journals each day, I knew exactly what I needed to review or re-teach the following day. By the end of the unit, the assessment scores were not a surprise to me. The level of understanding that the participants

displayed in their mathematics journals aligned with their scores on their second assessment which was given after journals were implemented in to mathematics.

Implications

According to researchers, there are many benefits of incorporating journal writing in mathematics. Many of the benefits of journal writing in mathematics that were stated by researchers were the same as what I found at the conclusion of my study. Bosse and Faulconer (2008), Fernsten (2007), Quinn and Wilson (1997), Seto and Meel (2006), and I agree that some of the benefits of incorporating journal writing into mathematics are that journal writing in mathematics assists students in developing a deeper understanding of the mathematics concept. It is a good communication tool between the teacher and the student. It is an excellent tool that teachers can use to assess the progress of their students, and it is a reference tool that students can use on their own to answer questions that they may have.

According to Baxter, Woodward, and Olson (2005), journal writing in mathematics is a good communication tool between the teacher and the student. After completing this study, I found this that journal writing in mathematics served an invaluable communication tool between the participants and me. After reading through the students' journals each day, I had a better understanding of where the participants were in their learning of the mathematics concept than before I introduced journal writing into mathematics. I used the journals to make decisions on what concepts needed more time and additional instruction. I could also clarify things

to individual students or to the class depending on how many people made the same mistakes.

Seto and Meel (2006) and I agree that journal writing in mathematics is an excellent way to develop or improve relationships between the teacher and the students. When the participants first began to write in journals, they often did not write a lot and did not ask any questions or write any comments to me. After the participants received comments and feedback from me, they began to start writing comments and questions to me. The participants realized that I was reading the journals each day and therefore, took more time with their writing and often made a comment to me. In order to encourage the participants to write back to me, I often would ask them questions in their journals that they could answer only by writing back to me. Sometimes the questions and comments were not on the topic of mathematics. Even though some comments from the participants were off topic, I often learned things about them that I might never have learned if it were not for the communication that we had through the mathematics journals. Journal writing in mathematics did in fact improve the relationships between the participants and me.

Norwood and Carter (1994) wrote an article titled *Journal Writing: An Insight into Students' Understanding* which argued that mathematics journals are a good tool for students to use to assess their own understanding of the mathematics concept. During the study, when the participants struggled to write about a given mathematics problem, they learned that they needed to ask questions to clarify any misunderstandings. If the participants did not ask questions, then they hit a road block

and could no longer write anymore. Many times, my students did not care to ask questions when they were unsure about something and just let it go. The writing in mathematics forced the students to take more responsibility for their education by forcing the students to ask questions when they were confused so that they were able to complete their journal entries.

Baxter, Woodward, and Olson (2005) and Scheibelhut (1994) argue that journal writing in mathematics provides the students with a source that they can use as a reference when they are confused about something that they have already learned and written about. My goal as an intermediate teacher is to assist students in becoming more independent. In order to accomplish this goal, when the participants asked me questions about something that was already covered in class and they wrote about in their journals, I encouraged them to review their journals to see if they could answer the questions on their own. Many times the students were able to answer their own questions because of this resource. Journal writing in mathematics assisted me in helping the students to become more independent in class and helped the students to develop confidence in mathematics.

Quinn and Wilson (1997) and Seto and Meel (2006) and I agree that there are some drawbacks of journal writing in mathematics. One drawback was the time it took to incorporate journal writing in my math work periods. The work period is a time where students can practice a new concept that was taught by the teacher. There is already a lot that needs to be done during a math period. During each math period, there is a ten to fifteen minute mini lesson where the students are taught a new skill, a

forty minute work period where the students practice the new math skill, and a ten minute closure where the students share what they have learned. During the study, I found myself to be very tense because there is already so much to fit in during the hour mathematics period and on top of that, I needed to set aside time for the students to write in their math journals. It put a lot of pressure on me because I wanted to get through everything. In the end, I found that even though it was stressful to fit everything in to the hour lesson, the benefits of the journal writing in mathematics made it worth it.

Another disadvantage that was stated by Idris (2009) and that I also found during my study was that journal writing in mathematics took up a lot of time on the teachers' part. Teachers have numerous responsibilities to begin with and having to read student journals each day and provide feedback to the students can take up a lot of time. Even though reading the journals and providing feedback to the students was time consuming, it was worth it to me because it assisted me in understanding what concepts my students are proficient in and what they need further assistance with.

Limitations

One limitation of my study is the fact that I was both the teacher and the researcher. A disadvantage of being both the teacher and the researcher is the fact that bias could have affected the results of my study. It was difficult to set aside what I already knew about the students and not to make judgments regarding the participants as I filled out the checklist and made comments in the participant's journals.

Another limitation of my study was the fact that this study was completed over a limited time period. During the time period of my study, I had to state expectations of journal writing in mathematics, model sample journal entries, and allow students to get into the routine of journal writing during mathematics. If the study was done over a longer period of time, then the results of the study may have differed.

Even though the assessments that were used during my study had the same format, the fact that the first assessment was on adding and subtracting decimals and the second assessment was on multiplying and dividing decimals served as a limitation to my study. The assessments were similar because they both covered decimals, but they differed in the fact that each assessment covered different operations. This posed as a limitation because students may not have the same capabilities with all four operations. Students' strengths and weaknesses when solving problems with different operations may have affected the results of my study.

Final Remarks

After the completion of this study, I learned that journal writing in mathematics is an effective tool for students in increasing comprehension of mathematics concepts. There were many benefits to writing in mathematics. Some of these benefits include that journal writing in mathematics increases student comprehension of mathematics concepts and it is a good source of communication between the teacher and the students. Also, journal writing in mathematics can be an excellent reference tool that students can use if they forget something that was

already taught by the teacher and journal writing in math can also show teachers what concepts students need additional assistance with. There are also some disadvantages to integrating journals into mathematics lessons. Some of these disadvantages include that it is time consuming for the teacher because they have to go back and read the journals and provide feedback to each student and also journal writing takes up a time that could have been used to complete practice problems on the concept that was taught that day.

After weighing the pros and cons of incorporating journal writing into mathematics lessons, I believe that the benefits outweigh the drawbacks. The disadvantages of journal writing in mathematics all have to do with it taking up too much time in class and for the teacher when they have to read through them and make comments back to the students. I believe these drawbacks are minor compared to the multitude of benefits that students will receive if journal writing is incorporated into mathematics lessons. Therefore, I plan on introducing journal writing to my entire class and incorporating it into mathematics lessons on a regular basis.

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Appendix A: Mathematics Checklist
Knowledge of Mathematic Concept/ Engagement in Mathematic Activity

Student Number _____

Mini Lesson

	Yes	No	Comments
Concept is new to student.			
Student has been exposed to concept previously.			
Student is focusing on mini lesson without being distracted.			
Student is participating when teacher asks questions.			
Student correctly communicates answers to questions asked by teacher.			

Work Period

	Yes	No	Comments
Student begins work immediately following mini lesson.			
Student chooses to work alone.			
Student chooses to work in a group.			
Student is working in a group that he/she can focus on his/her work in.			
Student is actively engaged in work in group or individually.			
Student asks for help when necessary.			
Student completes work without teacher support.			
Student completes work with teacher support.			
Work is complete and accurate.			

Closure

	Yes	No	Comments
Student participates in closure.			
Student can answer and explain math concept correctly.			

Appendix B: Assessment 1

Name: _____

Date: _____

Addition and subtracting of decimals test (before implementation of mathematics journals).

Directions: Solve

1. $12.343 + 1.95 =$ _____

2. $14.78 - 12.857 =$ _____

3. $132.7 - 54.721 =$ _____

4. $2.6 + 124.938 =$ _____

Directions: Circle the letter of the answer that best completes the statement.

5. All of the following words mean to add except:

- a. sum
- b. from
- c. total
- d. all together

6. All of the following words mean to subtract except:

- a. difference
- b. take away
- c. remove
- d. product

7. Noah went to the store and bought a bag of chips for \$1.29, a bag of skittles of \$0.99, and a box of cupcakes for \$3.29. What was the total of the bill?

- a. \$5.57
- b. \$5.59
- c. \$6.57
- d. \$5.75

8. Jen's total bill at Wal-mart was \$17.87. If she paid with a \$20.00 bill, how much money did she get back from the cashier?

- a. \$3.87
- b. \$2.87
- c. \$2.13
- d. \$3.13

Directions: Solve each word problem and write the answer on the line.

9. Mr. Escobar took a trip to Pennsylvania in January. He filled his van with gas five times over the trip. The amounts he bought were: 10.6 gallons, 12.725 gallons, 1.25 gallons, 2.3 gallons, and 10.257 gallons. How many gallons of gasoline did he buy on the trip?

Explain the process you used to find your answer.

10. Mrs. Mull is saving her money to buy a new bicycle. She already has \$64 and she earned another \$12.50 for babysitting. The bicycle she wants is \$119.82. How much does she have left to save up? _____

Explain the process you used to find your answer.

Appendix C: Assessment 2

Name: _____

Date: _____

Multiplication and division of decimals test (after implementation of mathematics journals).

Directions: Solve

1. $7.62 \times .49 =$ _____

2. 7.02 divided by .9 = _____

3. 32.2 divided by 7 = _____

4. $9.1 \times .61 =$ _____

Directions: Circle the letter of the answer that best completes the statement.

5. Which term describes the answer in a multiplication problem?

- a. product
- b. total
- c. quotient
- d. difference

6. Which term describes the answer in a division problem?

- a. product
- b. sum
- c. quotient
- d. take away

7. A deli charges \$3.45 for a pound of turkey. If Tim wants to purchase 2.4 pounds of turkey, how much will it cost?

- a. \$1.44
- b. \$8.28
- c. \$14.40
- d. \$82.80

8. A six pack of orange soda costs \$4.20. How much does each can in the pack cost?

- a. \$0.07
- b. \$7.00
- c. \$70.00
- d. \$0.70

Directions: Solve each word problem and write the answer on the line.

9. Ms. Greenaway is grading math tests. A student's work on a problem is given below:

$$1.26 \times .43 = 5.418$$

Is the student correct? Explain your answer.

8. One dozen eggs cost \$1.25. How many whole dozens of eggs can be bought for \$6.00?

Explain the process you used to find your answer.
